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Distance Learning Technologies in the Knowledge Transfer System of a Modern University

Abstract

This article presents the results of a research conducted within the European IRNet Project. In the research, the place and role of the distance learning technologies in the knowledge transfer system of a modern university were described. The main goal of the article is to describe the results of the data domain analysis concerning the possibility of development and introduction of the academic massive open online courses (MOOC) platform. The authors identified the architecture and main functional requirements to the academic MOOC platform as an effective tool to optimise the processes of knowledge transfer in the system of teacher-student.

K e y w o r d s: Distance learning, information technologies, knowledge transfer, progressive pedagogy

Introduction

The activity of higher educational institutions is accompanied with substantial material, information, human, and monetary flows, which inevitably leads to the necessity of solving the task of their management. Higher educational institutions are more often considered from the point of view of effective management, while the instalment of automated information analytical and search or recommendation

systems is becoming an inalienable part of higher educational institutions' management.

In its general sense, the definition of knowledge transfer covers the transition of certain scientific ideas or scientific problems into a different scientific field, in which due to this a new, previously non-existent, scientific, and practical zone is formed. This definition is widely used for describing informational processes of spreading knowledge accumulated by the universities and is one of the priority directions of modern societies' development. The university knowledge circulates within the system "knowledge creator (provider)–knowledge consumer." This paper presents outcomes of the Work Package 5 conducted by the research team from Dneprodzerzhinsk State Technical University within the framework of the international project IRNet – International Research Network for the study and development of new tools and methods for advanced pedagogical science in the field of ICT instruments, e-learning and intercultural competences. The work results correspond to the Work Package 5 tasks on development of the main components of a computer-oriented system of distance learning for the modern specialists' training. As a technology of distance learning, the academic massive open online courses (MOOC) platform design is considered.

Academic MOOC Platform Design as a Special Type of University Knowledge

The information environment in which the corporate university knowledge is formed is a totality of the following components (Ivanov, 2008):

- information resources of various kinds, which move data from a source to a consumer. Information resources of the university are a set of data presented in the form of documents, concepts, techniques, participating in the exchange of information, including the use of computers (Zhulyabin, 2011). Information resources in the form of data streams accompany all the processes of the university functioning, from reporting and accounting to scientific and educational;
- organisational structure providing the information environment operation. Within the framework of the organisational structure, the actors and the administrative management system can be identified. The actors are employees who perform information operations and can act as sources, processors, and consumers of data and knowledge. The information operations of the information environment actors include: data creation, collection, storage, processing, retrieval, dissemination and analysis, and operational management

decision-making. The administrative management system is a set of operations and organisational activities carried out in order to increase the efficiency of the university operation and to obtain objective data on the actual performance of the institution as a whole;

- information exchange environment, including information technology, software, and hardware. One of the ways to implement the information exchange environment is the use of information systems. Development and implementation of information systems can significantly reduce information operations of the information environment actors and perform automatic processing of data in the “challenge–response” regime.

The formation of a common information environment of the university as an integral part of the knowledge transfer system makes it possible to (Karpenko, 2015):

- unite the information systems of the departments,
- avoid data redundancy in the collection of primary information,
- get away from duplication of data processing operations,
- improve the information exchange in general,
- overcome the problems of interaction of distributed sources of information and knowledge,
- provide knowledge consumers with an access to the university information resources, and
- improve the efficiency of management of the information resources and knowledge in general.

In general, knowledge of the university is generated during the execution of three types of work (Yalova, 2015):

- educational work, which includes organisation of the students learning process in accordance with the prescribed documents, such as the curricula of specialties and specialisations for each qualification level;
- methodical work, which is the main source of information support of the process of preparation of qualified specialists. Methodical work includes: development of curricula and work programmes of the disciplines, lecture notes, guidelines for all kinds of activities and classes, test kits and examination tasks for the current and final control of knowledge, etc. The distribution of educational materials and their use in the learning process can be considered as a special kind of knowledge transfer, where under a “knowledge provider” we mean any teacher who develops teaching materials, and students who obtain knowledge in the framework of selected specialties are referred to as knowledge consumers;
- scientific work, the result of which is the creation of scientific articles, abstracts, and presentations at conferences, monographs, patents, theses, reports on budgetary and non-budgetary research works, inventions, innovations, scientific research, etc. A special type of scientific work is the creation of

information and training literature: textbooks and manuals. The transfer of knowledge gained in the course of research can be an effective means of developing the country's economy as a whole. It should be noted that in developed countries it is the universities who play the role of key economic engines in the process of creating new knowledge and its transfer to a non-academic sector.

The place of knowledge transfer system in the university's information environment is presented in the graphic form in Figure 1.

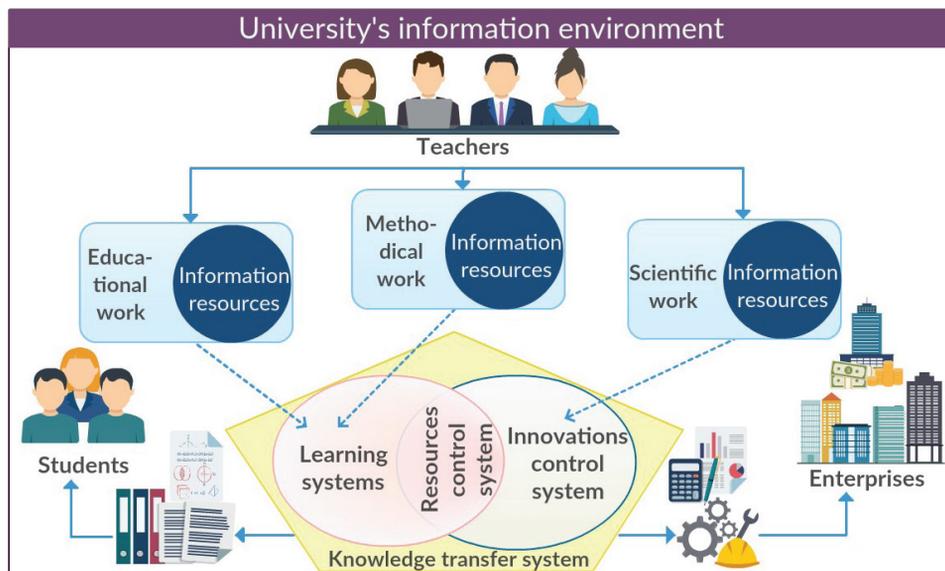


Figure 1. The place of knowledge transfer system in the university information environment

Source: Own work.

The results of scientific and methodical work of each teacher form generalised indicators of the university activity and characterise the level of its corporate knowledge, which finally influences:

- the national ranking of the university;
- the competitiveness of the university in the educational market and in the field of research projects implementation; and
- the success of the accreditation and licencing of areas of study, specialties, and the university as a whole.

The improvement of efficiency of management of the information environment and the accumulated knowledge of the university can be achieved by automating the management processes, and by introducing automated information systems for administrative control and e-learning systems (Arhipova, 2014). Their use can provide the following positive effects:

- the reduction of time and labour expenditures of information processing;
- the improvement of the quality of management due to a faster and more complete use of the accumulated knowledge and data base;
- the increase of the reliability of information, on the basis of which the decisions are made by the university administration, and minimising data entry errors;
- definition and effective use of the integrated indicators in the administrative management system, which will lead to the improvement of the operational management information support;
- construction of a common information environment of the university with the implementation of functions of electronic collecting, storing, processing, and generating data for the process of effective operational management decision-making; and
- the increase of the efficiency of knowledge transfer system operation by optimising the processes of collection, storage, and dissemination of knowledge.

In accordance with the kinds of information resources and the selected types of information work, we define and characterise two groups of automated information systems designed to improve the university knowledge transfer system:

1. Information systems increasing the efficiency of information and educational environment, and
2. Information systems optimising information processes of administrative management system.

Information systems increasing the efficiency of information and educational environment include (Bird, 2015): distance learning, Massive Open Online Courses, virtual classroom, IT tools such as LMS (Learning Management Systems), CMS (Contents Management Systems), VSCR (Virtual synchronous classrooms), SSA (Screen Share Applications), CSA (Contents Sharing Application), cloud computing environment, virtual campus, virtual learning environment, and “virtual synchronous classroom.” All of these types of information and computer resources belong to distance learning technologies.

Distance learning is the interaction between a teacher and students at a distance, reflecting all the typical components of the educational process (objectives, contents, methods, organisational forms, teaching aids) and realised by specific interactive media (Fisher, 2014).

The rapid development of information technology allows using computers not only for processing, storage, or transfer of information resources, but also as a means of organisation of the educational environment. The training systems using information technologies and providing training materials on the Internet are called E-learning Systems.

Using E-learning Systems and distance learning technologies will provide the following key benefits within the knowledge transfer system framework (Johnson, 2014):

1. Providing timely and round-the-clock delivery of e-learning materials.

2. Getting information support from the system in the form of consultations, advice, tips, and reference solutions. Obtaining theoretical knowledge, practical skills, and conducting self-control of acquired knowledge.
3. Giving the opportunity to set own rhythm of training and volume of received knowledge, which leads to the increase of intellectual potential through self-learning. In addition, E-learning Systems provide access to education for people with special needs.
4. Providing aggregated and generalised knowledge in a given area, freeing students from having to spend considerable time searching for information.

Academic MOOC Platform Design

Distance learning technologies have passed the stages of dissemination of educational materials via e-mail and e-learning systems (Gutiérrez, 2014) such as MOODLE (Modular Object-Oriented Dynamic Learning Environment) to the academic MOOC platforms such as EDX (Founded by Harvard University and MIT in 2012).

MOOC is a training course with massive interactive participation, the use of e-learning technology, and open access through the Internet. As a complement to the traditional materials of the course, such as videos, reading, and homework, MOOC gives an opportunity to use the interactive user forums, which help create and maintain communities of students and teachers.

The academic MOOC platform as a general term is a system created by means of information and digital technologies, providing a process of acquiring knowledge when a source of information and students are separated by time and distance. The word “academic” in the given definition refers to the mandatory compliance of the platform training materials to the established normative documents of the university specialties, namely curricula of specialties and work programmes of disciplines.

In general, the development and introduction of the academic MOOC platform at the university makes it possible to (Moreno, 2011):

- provide distributed access to electronic versions of educational materials created by teachers, by cycles of disciplines, within a given form of training, a qualification level, and a term;
- optimise the dissemination process and to unify the representation of the electronic versions of training materials;
- provide tools for the creation of electronic assignments and tests for the evaluation of knowledge acquired by the students (intermediate and final control, and self-control);

- use different forms of theoretical material presentation: video lectures, multi-media clips, online workshop, etc.; and
- get statistics on the activity of students, the number of their accesses to training materials, the knowledge assessment results.

The architecture of the academic MOOC platform should have the following five levels (Design Solution, 2016):

1. User access – the level of user access to the data. It includes a graphical interface of the system, transferred through a browser;
2. Common services – the level of services providing storage of users' identifying data. Common services provide the collaboration among all users of the system (Synchronous / Asynchronous) and the event management (Calendar / Scheduling / Reminders) to support users' workflow;
3. Learning services, which provide core functionality for creation and use of the educational resources;
4. Database – the level of storage of all the data involved in the system. As a database of the system, relational databases, NoSQL-databases, or XML can be used;
5. Infrastructure – the level includes client-server network and physical hardware, utilising standard internet technology protocols.

A distinctive feature of the academic MOOC platform is the possibility of a system electronic content management, represented as a set of massive online courses. In addition, the use of the academic MOOC platform should also provide the following benefits for teachers:

- creation, editing, and organised distribution of the electronic version of training materials in a variety of video, audio, and text formats;
- positive impact on creativity, level of IT-competency, and qualifications of the teacher in accordance with the innovations in the field of information technology and progressive pedagogy; and
- automated receipt of statistics on the achievements of the students, their secure storage, and maintenance of an electronic journal of the teacher.

However, it will be necessary to pay particular attention to solving the following problems:

- the necessity of effective implementation of modules for practical training, which is particularly important for the specialties with practical and technical direction;
- determining the place and role of the academic MOOC platform services in the framework of the traditional full-time and distance education of the university; developing corporate rules and standards of its application;
- addressing the issue of information provision of the platform, defining the rules and requirements to the e-content of the system, the integration of an academic MOOC platform into the administrative management system of information resources and knowledge transfer of the university;

- the motivation of students and teachers to use the academic MOOC platform, the marketing promotion of distance learning services on the developed platform.

Despite the fact that the academic MOOC platform is essentially a software application, the latest achievements in the field of pedagogy should be taken into account in its implementation, and the representation of its e-content should be designed according to the educational methodology, theory, and technology of solving educational problems. The authors propose the following method of obtaining theoretical knowledge:

- learning the theoretical material in a textual form;
- using links to the description of each definition or concept of the lecture topic;
- applying multimedia support of the lecture material in the form of video lectures, walkthroughs, shorts, problem sets, voice instructions, etc.;
- creating a list of definitions or concepts that deserve special attention in learning;
- forming responses to the test questions on each topic of the material;
- creating electronic assignments and tests to check learning of the material of various kinds, such as: assignments with a choice of one correct answer, assignments with a choice of one wrong answer, assignments on establishing compliance, assignments with a choice of several correct answers, assignments with an open response;
- when receiving an incorrect answer to the control question of the topic, providing the correct answer and a link to the text from the theoretical material.

To learn any theoretical material, it is necessary to perform a series of mental activities. In the training unit development, the function of individualisation of educational activity should be implemented, which means having an alternative in gaining theoretical knowledge, namely:

- reading the theoretical material in a textual form;
- watching video lectures and video materials;
- using the encyclopaedia regime and automatically obtaining definitions for the selected term or concept;
- using the voice guidance of the training;
- forming one's own thesaurus from the most important aspects of the discipline;
- forming responses to test questions on the topic.

The insufficient quality of distance learning often depends on the ways of communication process organisation (Yalova, 2016). When building a dialogue within the academic MOOC platform, the psychological principles of the student's interaction with the system were taken into account. In order to avoid undue attention, which may cause a feeling of protest in the student, the optimal level of accompanying services has been defined. What was also taken into account is that excessive frequency of the external dialogue breaks the internal dialogue of the student. On the other hand, the implementation of tips and assistance of the

system should be sufficient to ensure that the student does not have a sense of helplessness. The authors propose to minimise meta-dialogue in the organisation of theoretical material learning process. With this purpose, before starting to learn theoretical material, the student is given a description of the topic, its abstract, and its aim. After receiving an affirmative answer about the readiness to learn theoretical material, a dialogue from the side of academic MOOC platform is not initiated as it can disrupt the process of student thinking. At the time of completion of each topic learning, the dialogue is renewed and the student is asked whether everything was clear for him or her, and whether he or she is willing to continue learning the new material.

One of the functional requirements which the authors impose on the academic MOOC platform is the application of a combined type of distance learning. On the one hand, the interactive training of students without a teacher's participation is organised, and on the other hand, each course of the platform must contain functional modules, which help the teaching staff carry out coordination and control of knowledge acquired by students.

As for any software application, a life cycle of the academic MOOC platform development consists of five main stages: analysis of the functional requirements or domain analysis, design, implementation, testing, and exploitation. Using a spiral life cycle model for the academic MOOC platform development provides an opportunity to simultaneously have a working version of the software application, to specify the requirements of the project, to determine its quality, and to plan work on the next version.

Under the domain analysis, the type of research is meant in which a real or imaginary object is divided into its component parts (elements), and these elements and relationships between them are studied.

The research included the functional model and object model development. For these purposes, the authors used a function-oriented method of the business process description and an object-oriented method of domain structure designing.

The created functional model of the academic MOOC platform allows one to determine the roles of system users – students, teachers, staff of the education quality monitoring centre, and unregistered users – and describe the actions available for every type of user. For the formalised representation of information on a functional model of the academic MOOC platform, the authors developed a mathematical model which can be described as a system specified as a set of processes $E = \{E_1, \dots, E_N\}$, by relations between the processes G and a dictionary of glossaries S of each level of the model. The obtained mathematical model allows us to display the analysed domain in a formal way, taking into account its decomposition into elementary functional steps, describing relationships between objects, schemes, and algorithms of their interaction.

The object model is a static display of the domain structural components. The structural components include: entities, their characteristics, and the charac-

teristics of relationships between entities. The created object model can describe data domain mathematically and consists of a multitude of entities, a multitude of characteristics of entities of the domain, and a multitude of relationships between the objects with a given multiplicity of relationship.

Peculiarities of the International IRNet Project Results Used for Development of the Knowledge Transfer Mechanism of a Modern University

The Dniprodzerzhynsk State Technical University takes part in the academic collaboration programme “International Research Network for study and development of new tools and methods for advanced pedagogical science in the field of ICT instruments, e-learning and intercultural competences.” The project is financed by the European Commission under the Seventh Framework Programme, within the Marie Curie Actions International Research Staff Exchange Scheme.

The project aims to (IRNet, 2016):

1. Set up a thematic multidisciplinary joint exchange programme dedicated to development of new tools for advanced pedagogical science in the field of ICT instruments, distance learning, and intercultural competencies in EU, Australia, Ukraine, and Russia;
2. Strengthen collaboration between the EU and third country institutions through mutual internships of researchers.

The project is divided into 7 Work Packages. From 01 January 2016 to 01 August 2016, the tasks of the Work Package 5 “Pilot methodology development” are being performed, including (IRNet, 2016):

- defining some most important skills of the contemporary specialist course profile;
- identification and theoretical justification of the principles, forms, methods of effective use of the ICT, and remote forms of teaching in the education in higher pedagogical educational institutions;
- defining and testing a computer-oriented methodical and theoretical scientific system for competences developing, which includes: 1) psychological and pedagogical aspects; 2) organisational and methodical security curriculum; 3) implementation of the social contract in such educational requirements for training future and in-service teachers; 4) protection of the learning process of computerisation measures, information, methodological and technical support of the school, and the cognitive activity of in service and future teachers and other specialists with extensive use of distance forms of learning, based on

Internet technologies; 6) adequate information on competences components including e-learning and intercultural competences;

- development of theoretical-methodological, psychological, pedagogical, and methodological foundations of distance learning science based on Internet technologies;
- identifying and characterising organizational forms, models and remote types of courses, case-technologies, social media, Web 2.0 and Web 3.0, Internet-courses.

The developed functional and object domain models for creation of an academic MOOC platform can be successfully used in the implementation of the IRNet project Work Package 5 tasks, such as (IRNet, 2016):

- to develop, theoretically justify, and experimentally verify the basic concept of shaping the location ICT teachers competences in the use of information and communication technologies and remote forms of teaching in their professional activities;
- to develop, theoretically justify, and experimentally verify the basic components of a computer-oriented system of methodical preparation of contemporary specialists;
- to develop the content, forms, methods, technologies.

Conclusions

The academic MOOC platform, proposed for development, has the following advantages:

- it is free of charge, has low system requirements to software and hardware platform, and there is no need to use licenced software for its operation;
- unlike the existing systems of distance learning, it provides an automatic control mode to control the learning process of students of all forms of studies;
- it provides a possibility of automatic evaluation of the quality of obtained knowledge and formation of statistical data of the system;
- it reproduces the traditional interaction between a teacher and a student through the mechanism of support of data and files sharing, and effective feedback;
- it ensures the effective interactive navigation on educational materials depending on the set trajectory of learning; and
- it provides e-content, electronic tasks, and tests in different formats and forms with the use of multimedia.

The authors expect to get the following social effect of the academic MOOC platform introduction:

- maintaining an adequate level of higher education under conditions of continuous decrease of classroom hours;
- increasing the intellectual potential of youth through self-education;
- ensuring the availability of education for people with special needs; and
- having a positive impact on the creativity and the level of IT-competencies of teachers according to the innovations in information technology.

The software implementation of the academic MOOC platform adjusted for the functional requirements generated by the authors will provide a positive impact on the knowledge transfer system in the university due to:

- providing a shared access to electronic versions of educational materials created by teachers within a given form of studies and a qualification level. A shared access is realised through the introduction of roles for users to separate their access to data. The smallest amount of data is available for unauthorised users; the most extensive system administration rights are given to the staff of the university knowledge transfer unit;
- optimising the structure of knowledge presentation with a possibility to add, edit, delete information resources;
- introducing the virtual instruments of creation of electronic assignments and tests to evaluate knowledge obtained by students (self-control and evaluation control) with a possibility of adjusting the parameters of knowledge testing and data storage;
- improving the quality of monitoring and administrative functions of teachers through obtaining statistical data regarding the activity of students, the popularity of the topics of disciplines, the number of references to theoretical material and materials of practical orientation, the results of evaluation assignments and self-control.

The results of the creation of a functional and object domain model provide the opportunity to develop architecture of the platform, highlighting its function modules and defining the rules of distribution rights of access to data based on the roles of users of the system. To manage the e-content of the academic MOOC platform, the functions of adding, deleting, editing, moderation information resources, data search, or obtaining results of data-mining should be provided for administrators. The data on the number of users, the amount of transmitted data, or the waiting time restrictions for issuing the queries results open up the opportunity to set technical and hardware specifications of the academic MOOC platform servers.

According to the research results, the authors see an opportunity to use distance learning technologies in the form of the academic MOOC platform as effective tools for improving the quality of knowledge transfer system of a modern university. The obtained results can be used in the course of implementation of the IRNet Work Package 5 for developing a methodology of information technology application in teaching.

Acknowledgements

The research leading to these results has received, within the framework of the IRNet project, funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme FP7/2007–2013/ under REA grant agreement No: PIRSES-GA-2013-612536.

This paper is published thanks to the support of the Dneprodzerzhinsk State Technical University (Ukraine).

Authors express special gratitude for the help in the publication to Professor Eugenia Smyrnova-Trybulska.

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Technologie kształcenia na odległość w systemie przekazywania wiedzy na nowoczesnym uniwersytecie

Streszczenie

Niniejszy artykuł prezentuje wyniki badania przeprowadzonego w ramach europejskiego projektu IRNet. W badaniu opisano miejsce i rolę technik kształcenia na odległość w systemie przekazywania wiedzy na nowoczesnym uniwersytecie. Głównym celem artykułu jest opisanie wyników analizy domeny danych dotyczącej możliwości opracowania i wprowadzenia platformy akademickich masowych otwartych kursów online (MOOC). Autorzy określili architekturę i główne wymagania funkcjonalne akademickiej platformy MOOC jako efektywnego narzędzia optymalizacji procesów przekazywania wiedzy w systemie nauczyciel-student.

S ł o w a k l u c z o w e: kształcenie na odległość, technologie informacyjne, przekazywanie wiedzy, pedagogika progresywna

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Технологий дистанционного обучения в системе передачи знаний современного университета

Аннотация

В данной статье представлены результаты исследований, проведенных в рамках Европейского проекта IRNet. В исследовании описаны место и роль технологий дистанционного обучения в системе передачи знаний современного университета. Основная цель статьи состоит в том, чтобы описать результаты анализа предметной области, касающихся возможностей использования, разработки и внедрения платформ массовых открытых онлайн курсов (MOOCs). Авторы определили архитектуру и основные функциональные требования к академической MOOC платформе.

К л ю ч е в ы е с л о в а: Дистанционное обучение, информационные технологии, передача знаний, прогрессивная педагогика

Kateryna Yalova, Valerii Zavgorodnii, Ksenia Yashina, Oleksandr Sadovoy

Tecnologías de enseñanza a distancia en el sistema de transferencia de conocimientos de una universidad moderna

Resumen

Este artículo presenta los resultados de una investigación realizada en el marco del proyecto europeo IRNet. Se describió en primer el lugar el papel de las tecnologías de aprendizaje a distancia en el sistema de transferencia de conocimientos de una universidad moderna. El objetivo principal del artículo es describir los resultados del análisis realizado sobre la posibilidad de desarrollo de una plataforma de cursos en línea masiva (MOOC). Los autores identificaron la arquitectura y los principales requisitos funcionales de la plataforma académica MOOC como una herramienta eficaz para optimizar los procesos de transferencia del conocimiento.

Palabras clave: Aprendizaje a distancia, tecnologías de la información, transferencia de conocimiento, pedagogía progresiva